Barred Sand Bass, *Paralabrax nebulifer*
Enhanced Status Report

Barred Sand Bass, *Paralabrax nebulifer* (Photo Credit: Miranda Haggerty, CDFW).

California Department of Fish and Wildlife
Marine Region

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Enhanced Status Reports

The Marine Life Management Act (MLMA) is California's primary fisheries law. It requires the California Department of Fish and Wildlife (Department) to regularly report to the California Fish and Game Commission (Commission) on the status of fisheries managed by the state. The 2018 Master Plan for Fisheries expanded on this general requirement by providing an outline for Enhanced Status Reports (ESRs) that is based on the MLMA's required contents for Fishery Management Plans (FMPs). The goal of ESRs is to provide an overview of the species, fishery, current management and monitoring efforts, and future management needs, and provide transparency around data and information that is unavailable or unknown. ESRs can help to guide Department efforts and focus future partnerships and research efforts to address information gaps and needs to more directly inform management. It is also anticipated that some ESRs will be foundations for future FMPs by providing background information and focusing analyses and stakeholder discussions on the most relevant issues.

Note that in order to describe management measures in clear terms, ESRs contain summaries of regulatory and statutory language. To ensure full compliance with all applicable laws and regulations, please refer directly to the relevant sections of the Fish and Game Code and/or Title 14 of the California Code of Regulations.

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List of Acronyms

CalCOFI	California Cooperative Oceanic Fisheries Investigations
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CPFV	Commercial Passenger Fishing Vessel
CPUE	Catch Per Unit Effort
CRFS	California Recreational Fisheries Survey
DPUE	Discards Per Unit Effort
ENSO	El Niño Southern Oscillation
EFI	Essential Fishery Information
FGC	Fish and Game Code
FMP	Fishery Management Plan
IGFA	International Fish and Game Association
MLMA	Marine Life Management Act
MLS	Marine Logs System
MPA	Marine Protected Area
MRFSS	Marine Recreational Fisheries Statistics Survey
MSE	Management Strategy Evaluation
NGO	Non-Government Organization
NPGO	North Pacific Gyre Oscillation
PDO	Pacific Decadal Oscillation
RecFIN	Recreational Fisheries Information Network
SST	Sea Surface Temperature
TL	Total Length

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Fishery-at-a-Glance: Barred Sand Bass

Scientific Name: *Paralabrax nebulifer*

Range: Barred Sand Bass range from Santa Cruz, California, to southern Baja California, Mexico, but are rare north of Point Conception.

Habitat: Barred Sand Bass inhabit the ecotone, which is the transitional habitat where sand or mud bottom meets coastal rocky reefs. They also utilize deep sandy and muddy areas with intermittent patch reef at depths ranging from 10.0 to 30.0 meters (32.8 to 98.4 feet) for spawning aggregations. Juveniles are abundant over shallow sandy bottoms in bays and estuaries at depths of 1.5 to 6.0 meters (4.9 to 19.7 feet).

Size (length and weight): Barred Sand Bass can measure up to 67.0 centimeters (26.4 inches) Total Length and 6.0 kilograms (13.0 pounds).

Life span: The oldest recorded Barred Sand Bass is 24 years old.

Reproduction: Barred Sand Bass release their eggs into the water column where fertilization takes place. Adult fish form large annual breeding aggregations at specific locations within the Southern California Bight (Point Conception to San Diego, including the Channel Islands), predominantly in July and August. Females can spawn multiple times throughout the season.

Prey: Adult Barred Sand Bass consume fish, octopus, crabs, polychaete worms and ascidians (sea squirts or tunicates). Juvenile Barred Sand Bass primarily consume gammarid amphipods (scuds), but also eat small fishes, crabs, shrimp, snails, clams, octopus, and small crustaceans.

Predators: Barred Sand Bass are preyed upon by sharks and marine mammals such as Harbor Seals and sea lions.

Fishery: There is only a recreational fishery for Barred Sand Bass. They were historically fished commercially, but in 1953 commercial fishing for Barred Sand Bass was banned.

Area fished: Popular fishing grounds for Barred Sand Bass in California have historically included spawning aggregation sites, including Silver Strand, Del Mar and San Onofre in San Diego County; Huntington Flats in Orange County; Santa Monica in Los Angeles County; and Ventura Flats in northern Ventura County. Due to the disappearance of local spawning aggregations, many of these specific locations have not been targeted recently.

Fishing season: Barred Sand Bass are fished on coastal reefs year-round, but they are most commonly targeted in July and August when they form large annual spawning aggregations.

Fishing gear: Barred Sand Bass are primarily caught using hook and line, though spears are also used.

Market(s): There is no market for Barred Sand Bass given the lack of a commercial fishery.

Current stock status: No formal stock assessment exists for Barred Sand Bass, but abundance estimates indicate the population in southern California is severely depressed due to a combination of environmental conditions, poor recruitment and fishing pressure on easily targeted spawning aggregations.

Management: Barred Sand Bass, along with Kelp Bass and Spotted Sand Bass, have been managed collectively since the early 1900s. Due to concerns about the status of both Kelp Bass and Barred Sand Bass, the current bag limit of five fish in aggregate and minimum size limit of 14 inches (35.6 centimeters) was established in 2013. As of 2018, fishery-independent data over the past several years have shown increased juvenile abundances; however, these data are very limited. Fishery-dependent data indicate continued declines for Barred Sand Bass, and spawning aggregations have essentially disappeared, suggesting additional management measures may be necessary if the increased size limit and lower bag limit established in 2013 do not prove to be sufficient to protect the stock. To best support a stable Barred Sand Bass population and sustainable sport fishery, decisions on the specific management measures are pending the results of various models and fishery-independent data analyses.

1. The Species

1.1. Natural History

1.1.1. Species Description

Barred Sand Bass (*Paralabrax nebulifer)* are one of the most common sea basses inhabiting southern California coastal waters along with two other species of bass, Kelp Bass (*Paralabrax clathratus)* and Spotted Sand Bass (*Paralabrax maculatofasciatus*). Their coloration varies from grey to white, with distinct dark vertical bars on their sides that can quickly fade when caught. Barred Sand Bass are easily distinguished from Kelp Bass by the height of their third dorsal spine, which is much longer than the rest of their dorsal spines.

Figure 1-1. Adult Barred Sand Bass in kelp forest habitat (Photo Credit: Miranda Haggerty, CDFW).

1.1.2. Range, Distribution, and Movement

Barred Sand Bass range from Santa Cruz, California to southern Baja California, Mexico, but are more common south of Point Conception (Love et al. 1996b). Genetic analysis suggests that they make up one large population with high connectivity and genetic diversity among individuals from southern California to Mexico (Paterson et al. 2015). Juvenile Barred Sand Bass are abundant over shallow sandy bottoms in bays and estuaries at depths of 1.5 to 6.0 meters (m) (4.9 to 19.7 feet) (ft) (Mendoza-Carranza and Rosales-Casian 2002). Adults are typically found in deeper water ranging from 20.0 to 30.0 m (65.6 to 98.4 ft) at the sand/reef interface of natural and artificial reefs (Teesdale et al. 2015) but have been observed at depths up to 183.0 m (600.4 ft) (Eschmeyer and Herald 1999).

Figure 1-2. Range map for Barred Sand Bass.

Adult Barred Sand Bass have high site fidelity and their home range on reefs in southern California is 2.0 to 10.0 square kilometers (km^2) (1.2 to 6.2 square miles) (mi^2) (Mason and Lowe 2010; Teesdale et al. 2015), but movements can vary both daily and seasonally. For example, acoustic telemetry data indicate Barred Sand Bass use multiple habitats on or near the reef during the day, but are found over soft sediment habitat at night, signifying specific daytime feeding and nighttime resting periods (Mason and Lowe 2010). They are also bottom dwellers, rarely observed more than 2.0 m (6.6 ft) above the substrate outside of spawning season (McKinzie et al. 2014). During spawning season, Barred Sand Bass migrate from reefs to deep sandy areas where they aggregate and may reside, spawning multiple times across a 7 to 35 day period (Jarvis et al. 2010). Mark-and-recapture and telemetry studies suggest a portion of the total population moves from their home reefs to the same aggregation site on an annual basis and that spawning-related movements average 13.0 to 17.0 kilometers (km) (8.1 to 10.6 miles (mi)) (Jarvis et al. 2010; Teesdale et al. 2015) (Figure 1-3).

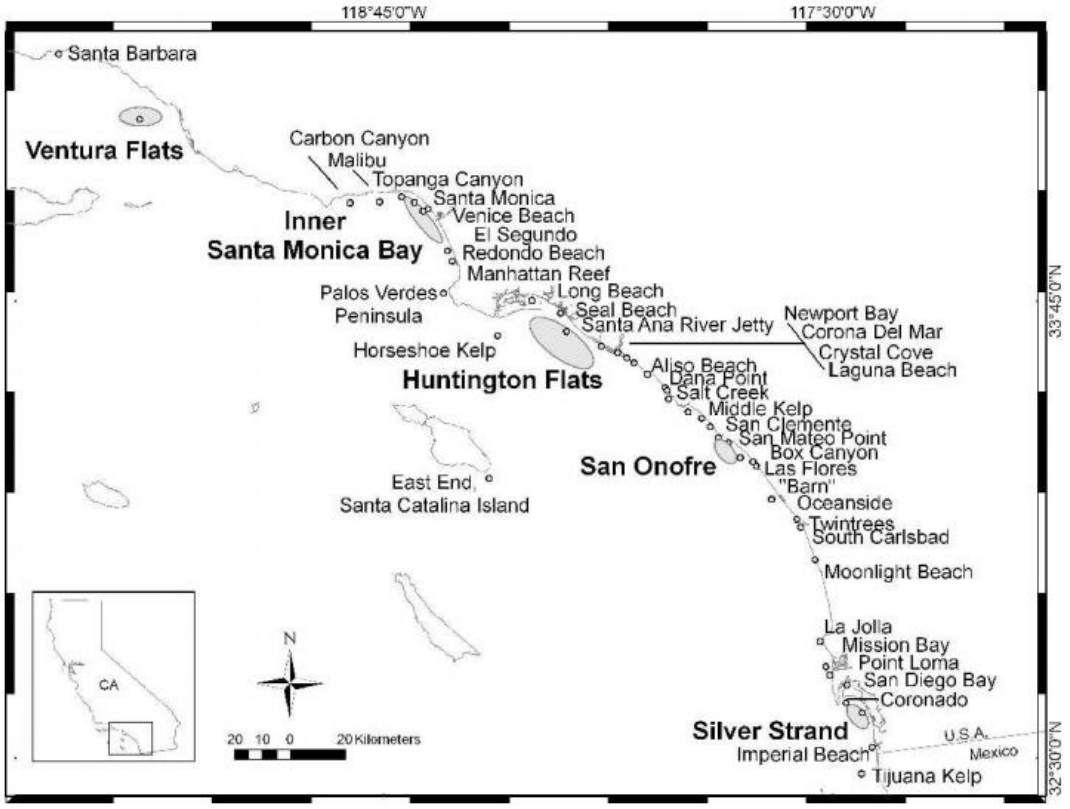

Figure 1-3. Map of Barred Sand Bass tagging locations from historical studies by the Department from the 1960s and 1990s. Ellipses identify historical spawning aggregation locations in the Southern California Bight (Jarvis et al. 2010).

1.1.3. Reproduction, Fecundity, and Spawning Season

Barred Sand Bass have two distinct sexes, and release eggs and sperm into the water column where fertilization occurs (Love et al. 1996b; Hovey et al. 2002). They form large annual breeding aggregations at specific locations within the Southern California Bight (Jarvis et al. 2010) (Figure 1-3). Fish in these aggregations spawn predominantly in July and August. Peak spawning occurs in the morning in areas of warm water, before new and full moon phases (Jarvis et al. 2014b). Females are batch spawners, so they develop eggs throughout the spawning season and spawn multiple times over the course of several days (Demartini 1987; Oda et al. 1993). Acoustic tracking of fine-scale vertical movements during spawning season suggest Barred Sand Bass spawn by following temperature gradients, and make repetitive vertical dives toward the seafloor to release eggs and sperm during the day (McKinzie et al. 2014). Although fish that migrate to spawning aggregation sites are known to be spawners (Jarvis et al. 2014b), it is unknown whether the fish that do not migrate still spawn.

After spawning occurs, fertilized eggs enter the plankton as larvae for approximately 1 month (Allen and Block 2012) and new recruits have been observed in eelgrass beds of sheltered bays and estuaries (Valle et al. 1999) and other shallow, nearshore waters in

the fall. Once fish near maturity (Total Length (TL) >23.0 centimeters (cm)) (9.1 inches (in)) they reside on coastal rocky reefs and sandy-muddy habitats.

1.1.4. Natural Mortality

Determining the natural mortality (M) of fish is important for understanding the health and productivity of their stocks. Natural mortality of a fish results from all causes of death not attributable to fishing such as old age, disease, predation or environmental stress. Natural mortality is generally expressed as a rate that indicates the percentage of the population dying in a year. Fish with high natural mortality rates must replace themselves more often and thus tend to be more productive. Natural mortality along with fishing mortality result in the total mortality operating on the fish stock.

Estimating natural mortality is difficult and often relies on evaluation of life history traits, and several different methods have been developed. Jarvis et al. (2014a) used growth parameters (L_{inf} and K) and average water temperature (Pauly 1980) to estimate a natural mortality rate of 19.5% annually. However, a study by Then et al. (2015) found that a method that used maximum age produced more reliable estimates of natural mortality. Using the maximum age ever observed in the population (24 years (yr)) suggests that the natural mortality is higher, and that 23.7% of the Barred Sand Bass population dies from natural causes each year.

1.1.5. Individual Growth

Individual growth of fishes is quite variable, not only among different groups of species but also within the same species. Growth is often very rapid in young fish, but slows as adults approach their maximum size. The von Bertalanffy Growth Model is most often used in fisheries management, but other growth functions may also be appropriate. Overall, the growth of Barred Sand Bass is relatively slow with no differences between the sexes. Growth is relatively fast during early years, but declines at around age 5 yr (Love et al. 1996b). Barred Sand Bass may reach 67.0 cm (26.4 in) TL and 6.0 kilogram (kg) (13.2 pounds (lb)) (IGFA 2001). The oldest fish recorded was 24 yr old (Love et al. 1996b). Growth parameters for Barred Sand Bass have been estimated for both sexes combined by fitting data to the von Bertalanffy growth function:

$$L_t = L_\infty(1 - e^{-k(t-t_0)})$$

where L_t is the length at age t, L_∞ is the maximum average length, k is the relative growth rate, t is the age of the fish, and t_0 is the theoretical age when the length of the fish is zero. The values of those estimated parameters are L_∞ = 66.2, k = 0.08, t_0 = -2.63 (Love et al. 1996b).

The relationship between weight and length for Barred Sand Bass (both sexes combined) has also been modeled using the exponential equation:

$$W = aL^b$$

where *W* is the weight in grams, *L* is the TL in millimeters, *a* is a constant indicating the intercept and *b* is a constant indicating the slope of the regression line (a=0.0000289 and *b*=2.95 for Barred Sand Bass) (Williams et al. 2013).

1.1.6. Size and Age at Maturity

Barred Sand Bass mature at a relatively small size and young age compared to other large reef fishes in California. An estimated 50% of male Barred Sand Bass reach maturity by 21.9 cm (8.6 in), between 2 to 4 yr old, and 50% of females reach maturity by 23.9 cm (9.4 in), between 2 to 5 yr old. All males are mature by 26.0 cm (10.2 in) and all females reach maturity by 27.0 cm (10.6 in) (Love et al. 1996b).

1.2. Population Status and Dynamics

No formal stock assessment exists for Barred Sand Bass in southern California; however, from the information available (Section 1.2.1) the population of Barred Sand Bass in southern California is severely depressed. Standard stock assessment methods may be inappropriate for species that form large spawning aggregations such as Barred Sand Bass, unless hyperstability (high catch levels even when populations are declining) and population thresholds for successful reproduction are accounted for when considering the catch history (Sadovy de Mitcheson 2016). Stocks targeted during spawning aggregations are particularly vulnerable to overfishing. In addition, population growth for species that form spawning aggregations may suffer at low population levels because fish cannot find others to mate with. Thus, recovery may take longer for Barred Sand Bass, even under conservative management.

1.2.1. Abundance Estimates

Abundance estimates from both fishery-dependent and fishery-independent sources indicate the population of Barred Sand Bass has declined and is severely depressed (Erisman et al. 2011) due to a combination of environmental conditions, fishing pressure, and poor recruitment (Jarvis et al. 2014a). The large annual spawning aggregations of Barred Sand Bass typically observed in southern California have been absent since 2013 and Catch Per Unit Effort (CPUE) is at its lowest point since a targeted fishery began in the 1980s (Bellquist et al. 2017) (also see Section 2.3.1). Aside from Commercial Passenger Fishing Vessel (CPFV) logbook and California Recreational Fisheries Survey (CRFS) estimates of catch and effort, annual estimates of the relative abundance of Barred Sand Bass are available from Occidental College's long-term SCUBA diver surveys of fish abundance along the King Harbor breakwater

(Los Angeles County). To our knowledge, these surveys are the sole ongoing, long-term, fishery-independent dataset that include an estimate of Barred Sand Bass abundance in their primary habitat. The diver survey data mirrors trends in fishery catch and effort, indicating that adult abundance has remained low since the mid-2000s (Figure 1-4). The data also show that there has been an increase in the number of juvenile recruits observed since 2013 which may represent strong recruitment classes that could lead to increased adult densities. However, the data from Occidental College only represent trends in abundance at a single location and thus they are best interpreted along with other supporting datasets.

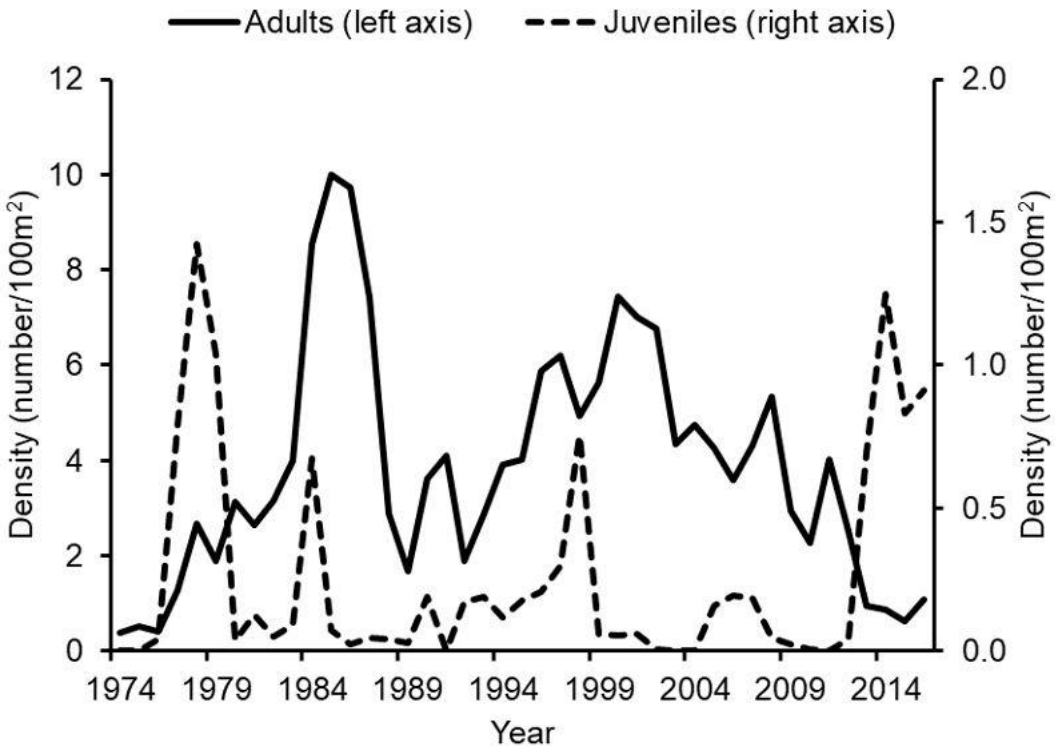

Figure 1-4. Annual trends in juvenile (<25 cm TL prior to 1991 and <15 cm TL thereafter) and adult (>25 cm TL) Barred Sand Bass abundance at King Harbor, Redondo Beach, Los Angeles County from 1974 to 2016 (Vantuna Research Group, Occidental College, unpublished data).

1.2.2. Age Structure of the Population

As there is no stock assessment for Barred Sand Bass, recreational catch data were used to assess the age structure of the population. Length data of retained catch from all fishing modes (CPFV, private/rental boats, man-made and beach and bank), with the majority taken from private/rental and CPFV modes, were converted to ages using a length-age key. Ages were estimated using the length at age relationship for Barred Sand Bass as reported in Love et al. (1996b). At least 12 age classes of Barred Sand Bass are represented in the catch for most years from 1980 to 2017 (Figure 1-5). From 1980 to 2012 there was a decline in the proportion of young fish (<6 yr old) in the

landings and a modest increase in the proportion of older fishes (>8 yr old). This pattern suggests there may have been a recruitment failure and that the fishery may not be successfully replenishing itself. In 2013 the size limit was increased from 12.0 in (30.4 cm) to 14.0 in (35.6 cm). This means that fish younger than about 7 yr old are now considered sublegal, and thus are no longer retained in the catch. The distribution of legal age classes (7-plus yr) in the landings remained relatively well distributed in 2018, suggesting that the adult population has a healthy age structure.

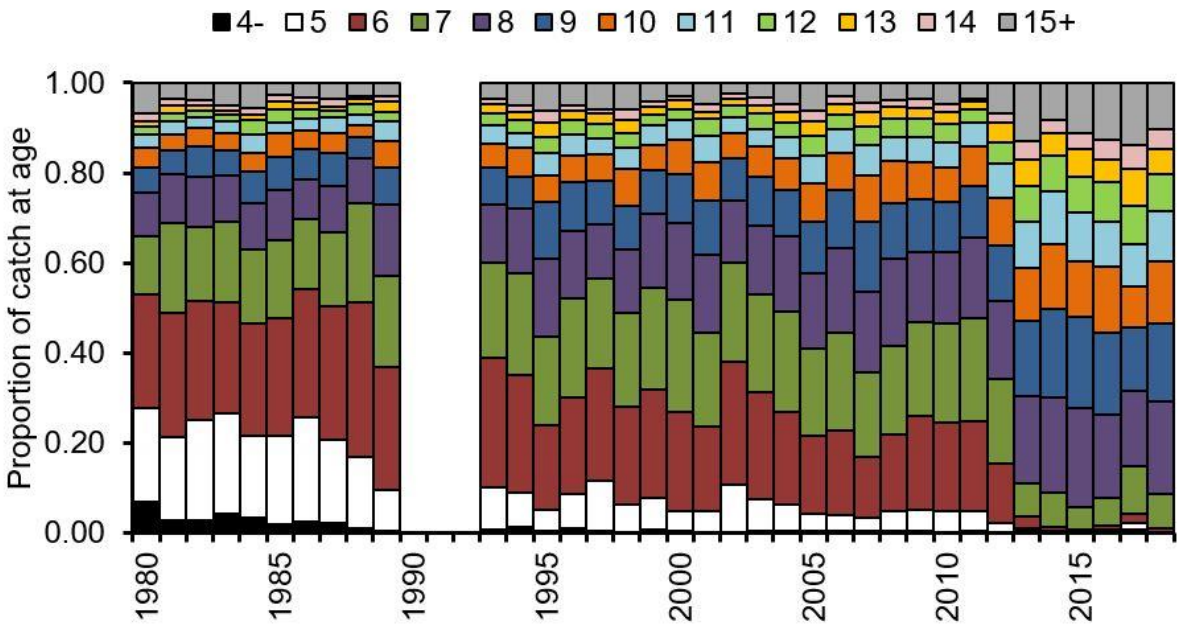

Figure 1-5. Age structure of harvested Barred Sand Bass from 1980 to 2018. Age classes were converted from length data of retained catch from all fishing modes. All fish older than 15 yr and younger than 4 yr are represented in summed categories, 15+ and 4-, respectively. A size limit increase in 2013 altered the distribution of retained fish. No data collected from 1990 to 1992 (Recreational Fisheries Information Network (RecFIN 2019)).

1.3. Habitat

Coastal rocky reefs, including artificial reefs, provide important habitat for adult Barred Sand Bass (Martin and Lowe 2010; McKinzie et al. 2014), while sheltered inlets and bays support nursery areas for juveniles (Mendoza-Carranza and Rosales-Casian 2002). Adults are most often observed along ecotone habitats where sand or mud bottom meets reef structure (Teesdale et al. 2015), but larger individuals may also be observed over the sand up to 33 m (108 ft) away from the reef edge (Anderson et al. 1989). Deep sandy and muddy areas with intermittent patch reefs are important habitats for spawning aggregations (McKinzie et al. 2014). Although Barred Sand Bass occur on the reefs of offshore islands in southern California (Mason and Lowe 2010), major spawning aggregation sites have only been observed along the mainland coast (Jarvis et al. 2010).

1.4. Ecosystem Role

Barred Sand Bass are generalist carnivores that can occur locally in great numbers during their spawning season. Spawning aggregations of Barred Sand Bass likely contribute to the ecosystem health of their spawning ground locations. Spawning aggregations of fish can contribute a substantial amount of nutrients in the form of egg masses as well as nitrogen and phosphorous waste products, supporting productivity in the local ecosystem (Erisman et al. 2015). The Department is not aware of any directed research on ecosystem impacts of the Barred Sand Bass fishery. However, heavy fishing pressure on Barred Sand Bass and the recent disappearance of historical spawning aggregations may have reduced prey availability for higher-level predators. It also may have reduced any annual nutrient input to local spawning grounds created by the aggregations.

1.4.1. Associated Species

Barred Sand Bass primarily reside in rocky reef, kelp forest, and reef/sand transitional habitats. The list of observed associated species below are the most common species found based on Department surveys conducted on reef ecotone (sand-reef interface) habitats (CDFW unpublished data). During spawning, Barred Sand Bass also occupy soft bottom habitats. Common soft-bottom habitat species (Allen et al. 2006) that may co-occur with Barred Sand Bass are also listed below;

Observed associated species:

- California Sheephead (*Semicossyphus pulcher*)
- Senorita (*Oxyjulis californica*)
- Halfmoon (*Medialuna californiensis*)
- Blacksmith (*Chromis punctipinnis*)
- Ocean Whitefish (*Caulolatilus princeps*)
- Garibaldi (*Hypsypops rubicundus*)
- Black Surfperch (*Embiotica jacksoni*)
- California Scorpionfish (*Scorpaena guttata*)
- Kelp Bass (*Paralabrax clathratus*)
- Pile Perch (*Rhacochilus vacca*)
- Brown Rockfish (*Sebastes auriculatus*)
- Opaleye (*Girella nigricans*)
- Rock Wrasse (*Halichoeres semicinctus*)
- Gopher Rockfish (*Sebastes carnatus*)

Other soft bottom habitat species:

- California Halibut (*Paralichthys californicus*)
- California Lizardfish (*Synodus lucioceps*)
- California Skate (*Raja inornata*)
- Cusk-eel (*Ophiodon scrippsae*)
- Diamond Turbot (*Hypsopsetta guttulata*)
- English Sole (*Parophrys vetulus*)
- Fantail Sole (*Xystreurys liolepis*)
- Hornyhead Turbot (*Pleuronichthys verticalis*)
- Queenfish (*Seriphus politus*)
- Round Stingray (*Urolophus halleri*)
- Shiner Perch (*Cymatogaster aggregata*)
- Speckled Sanddab (*Citharichthys stigmaeus*)
- Thornback Ray (*Platyrhinoidis triseriata*)
- White Croaker (*Genyonemus lineatus*)
- White Surfperch (*Phanerodon furcatus*)

1.4.2. Predator-prey Interactions

Juvenile Barred Sand Bass shelter and forage over sand and eelgrass habitats in protected bays (Valle et al. 1999). Gut contents analysis indicates that more than 50% of their diet is composed of gammarid amphipods, but they also consume small fishes, crabs, clams and isopods (Mendoza-Carranza and Rosales-Casian 2002). Adult Barred Sand Bass shelter and forage along benthic rocky reef and sand edges, or ecotone habitat (Teesdale et al. 2015). Adults consume fish, such as Plainfin Midshipman (*Porichthys notatus)*, Northern Anchovy (*Engraulis mordax*) and surfperch (*Embiotocidae* spp.), as well as octopus, crabs, bristle worms and tunicates (Roberts et al. 1984). In turn, Barred Sand Bass may be prey for larger piscivores such as sharks and marine mammals like seals and sea lions.

1.5. Effects of Changing Oceanic Conditions

Oceanic changes due to climate events impacting water temperature and nutrient availability such as El Niño Southern Oscillation (ENSO), the Pacific Decadal Oscillation (PDO) and the North Pacific Gyre Oscillation (NPGO) can have profound effects on fishes and fisheries. There may be long-term positive responses in bass populations to warm-water regimes since they are one of the few species whose recruitment (settlement of larvae from the plankton) has a significant correlation with the PDO (Hsieh et al. 2005). Larval survival is highest during extended periods of warmer than average Sea Surface Temperatures (SST) and lower during cooler water periods (Jarvis et al. 2014a) (Figure 1-6). This is expected since the population in southern California

exists at the northern edge of their distribution. In years when oceanic conditions are not ideal for recruitment (i.e. neutral to cooler water than average), heavy fishing pressure has had negative effects on the population (Miller and Erisman 2014). Thus, Barred Sand Bass are most vulnerable to overfishing during cool water regimes, but are likely to recruit well during El Niño years and other warm water events (also seen in Figure 1-4).

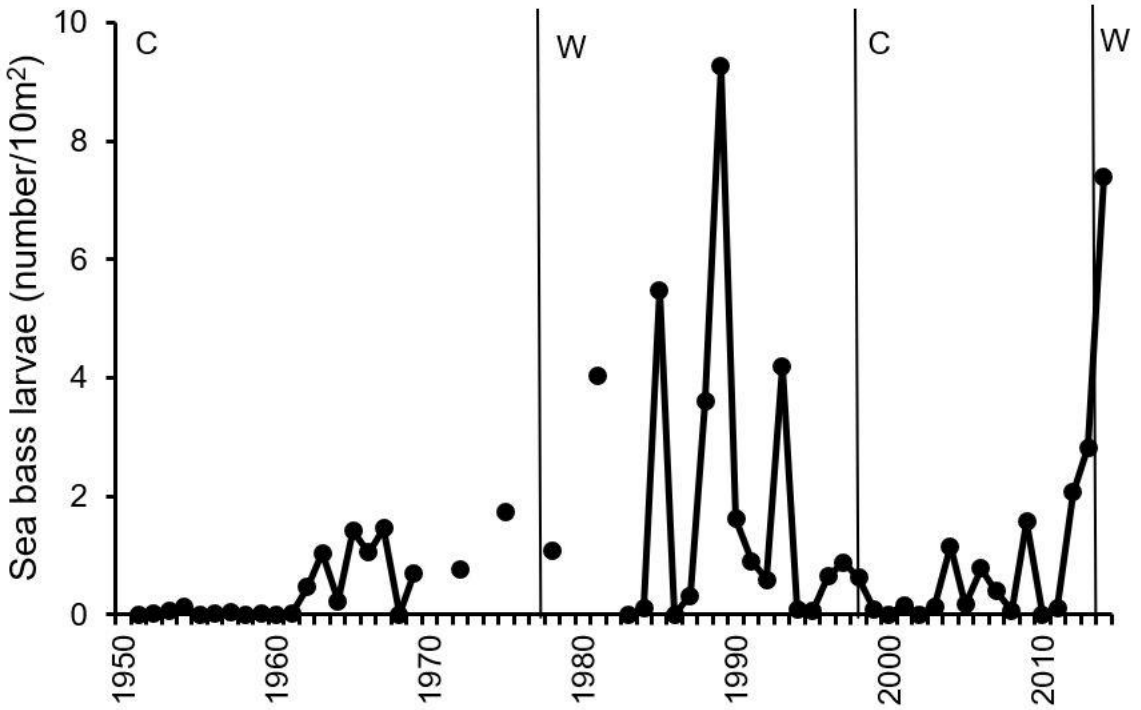

Figure 1-6. Annual variability in recruitment of sea bass (Barred Sand Bass, Kelp Bass and Spotted Sand Bass) based on quarterly plankton tows from 1951 to 2014. Warm and cool water regimes were determined from trends in the PDO Index. W = warm regime and C = cold regime (California Cooperative Oceanic Fisheries Investigations CalCOFI)).

2. The Fishery

2.1. Location of the Fishery

Barred Sand Bass are found from Santa Cruz, California south to Bahia Magdalena, Baja California, Mexico, but rarely occur north of Point Conception. They are fished on coastal reefs year-round, but most commonly targeted when they form large annual spawning aggregations over sand flats at depths of 10.0 to 30.0 m (32.8 to 98.4 ft) (Love et al. 1996a). Popular fishing grounds for Barred Sand Bass have historically included spawning aggregation sites such as Silver Strand, Del Mar and San Onofre in San Diego County, Huntington Flats in Orange County, Santa Monica in Los Angeles County and Ventura Flats in northern Ventura County (Figure 2-1) (Jarvis et al. 2010). They are not commonly caught at the offshore islands.

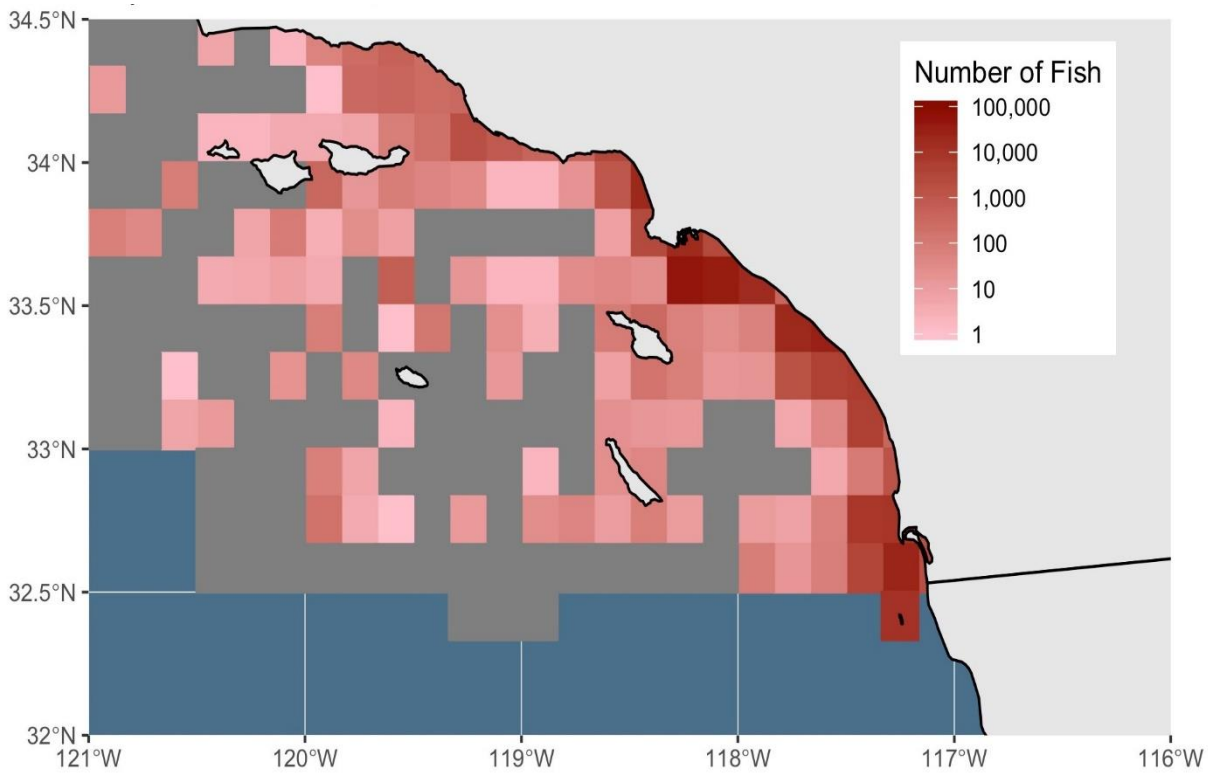

Figure 2-1. CPFV landings of Barred Sand Bass (kept and released) by block from 2013 to 2017. Grey area denotes fishing blocks where Barred Sand Bass were not landed (CDFW Marine Log System (MLS) 2018).

2.2. Fishing Effort

2.2.1. Number of Vessels and Participants Over Time

Saltwater anglers fish for Barred Sand Bass from party boats, private vessels, shore, piers, and jetties. Some small recreational charter boat trips began targeting Barred Sand Bass in the early 20th century but the CPFV fleet did not fully develop until after

1929 (Young 1969). Although Kelp Bass were the focus of the CPFV fishery in the 1950s and 1960s, Barred Sand Bass became a primary component of the CPFV catch in the 1980s (Jarvis et al. 2014a) with more than 11 million fish landed between 1980 and 2018 (CDFW MLS). In the late 1970s Barred Sand Bass began being targeted due to increased abundance from strong recruitment during a warm regime (Love et al. 1996a) and the ease of catching legal adults (Ally et al. 1991). While several modes of fishing are still used today, more than 70% of the catch is comprised of fish caught on CPFVs (Table 2-1).

Table 2-1. Percent of Barred Sand Bass catch (retained fish) in the recreational fishery by mode from 2004 to 2018 and the total number of Barred Sand Bass retained by all modes (RecFIN 2019).

Fishing mode	Percent of catch
Party/charter	71.7
Private/rental	26.2
Manmade	1.0
Beach/bank	1.1
Total fish retained	1,756,400

The annual number of CPFV trips targeting Barred Sand Bass (at least one caught per trip) remained relatively stable at approximately 6,000 to 8,000 trips per year from 1980 to 1995, peaked in 1998 at approximately 12,000 trips, and declined dramatically after 2001 to approximately 3,200 trips in 2018 (Figure 2-2). This is linked to a decline in the CPUE, with a substantial decrease in the CPUE of Barred Sand Bass at historical spawning sites (Figure 2-1).

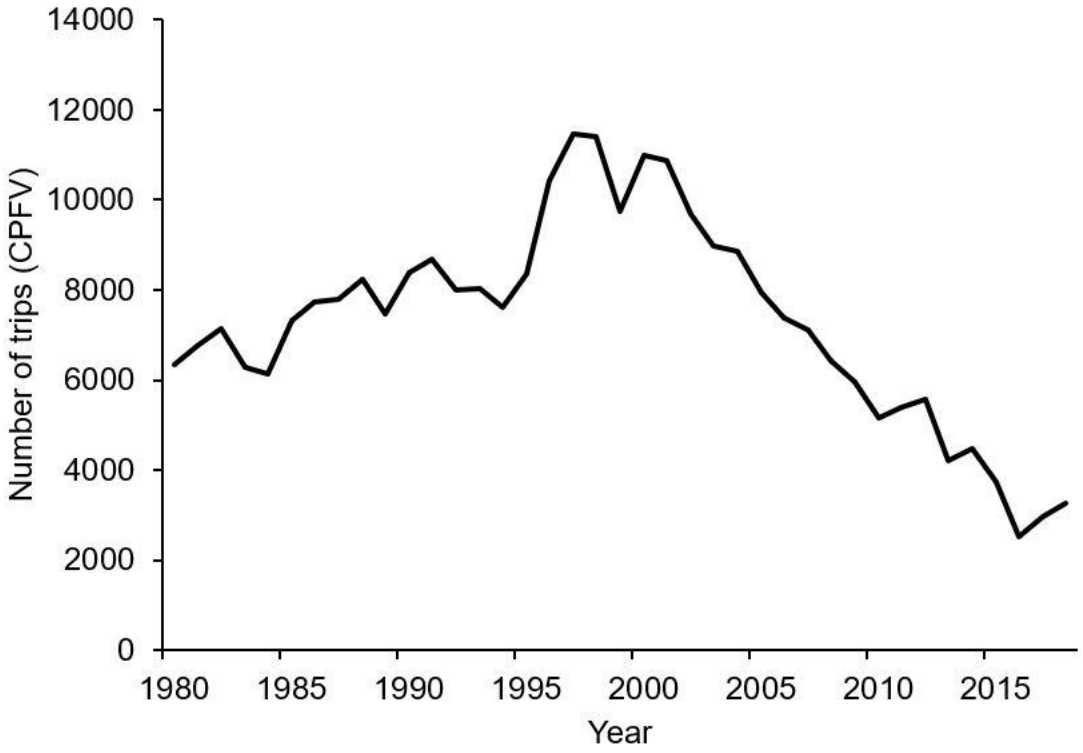

Figure 2-2. Number of CPFV trips in southern California targeting Barred Sand Bass (at least one caught) from 1980 to 2018 (CDFW MLS 2019).

2.2.2. Type, Amount, and Selectivity of Gear

Barred Sand Bass are caught primarily by hook and line, with a minor component taken by spear. Recreational anglers fishing from a boat or shore may use any number of hooks and lines. On public piers, no more than two rods and lines are allowed. Hook and line anglers typically use soft plastics and dead or live bait. Typical baits include squid, sardines, and anchovies.

The most common size of Barred Sand Bass caught by hook and line from 2013 to 2017 was 14.5 in (36.8 cm) and the average size was 15.6 in (39.6 cm) (RecFIN). However, these sizes may be slightly inflated since fewer discarded fish were measured relative to those that were legal size and kept.

Depending on the type of hooks and baits used, Barred Sand Bass much smaller than the legal size limit can be caught (and then must be released). An ongoing Department study monitoring bass discard rates aboard CPFVs has recorded Barred Sand Bass as small as 5.0 in (12.7 cm) being caught and released. However, catching Barred Sand Bass of that size is not common as the average size of Barred Sand Bass discarded is 12.0 in (30.5 cm) and the most frequently occurring size discarded is 12.6 in (32.0 cm).

2.3. Landings in the Recreational and Commercial Sectors

2.3.1. Recreational

Catch data for the recreational fishery are provided by two sources: (1) CPFV logbooks within the Department's MLS database and (2) CRFS estimates on all fishing modes available from the RecFIN website. In this ESR, historical logbook data (Hill and Schneider 1999) are used to report trends in the "rock bass" (Barred Sand Bass, Kelp Bass, and Spotted Sand Bass) category on CPFVs from 1947 to 1980, CRFS data are used to summarize trends in the private/rental boat mode from 2004 to 2018, and MLS logbook data are used to summarize trends in CPFV catch from 1980 to 2018. For further information on these datasets please see Section 4.2.1.

In southern California, Barred Sand Bass are caught year-round, but are most commonly fished during their annual spawning migrations in the summer months of June, July and August (Figure 2-3).

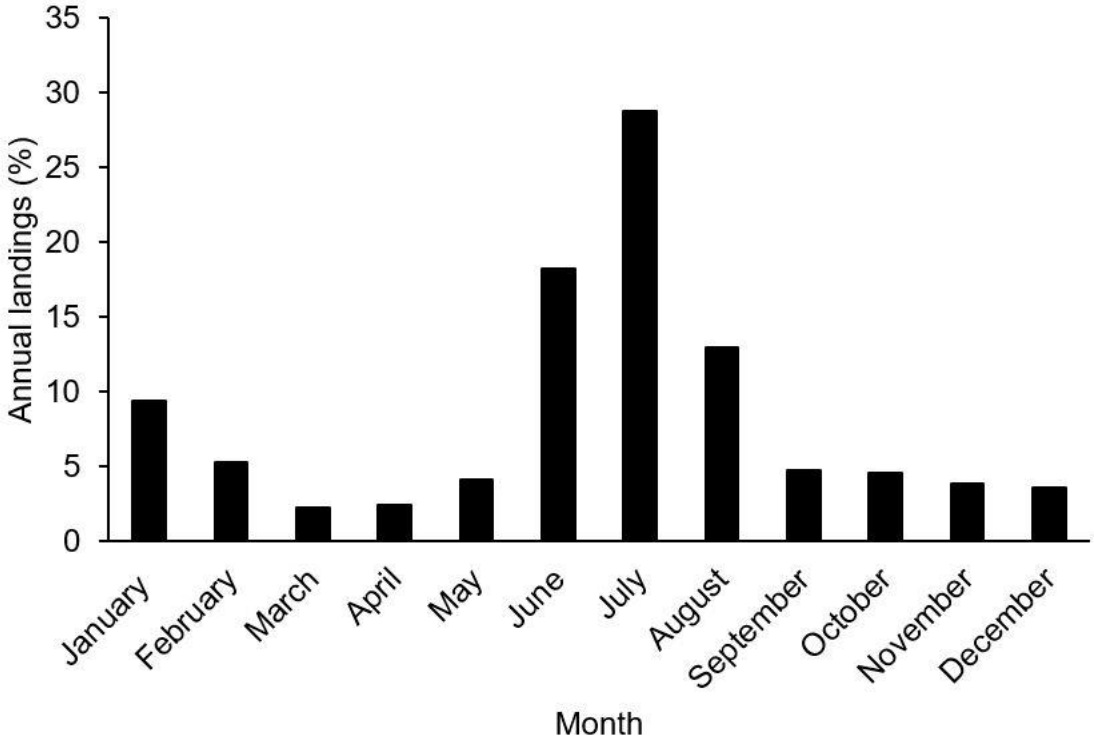

Figure 2-3. Proportion of the yearly CPFV landings of Barred Sand Bass (kept fish) by month in southern California from 2013-2018 (CDFW MLS 2019).

From the 1970s onward, Barred Sand Bass consistently ranked in the top ten species in the CPFV catch and they remained one of the most important species to the recreational fishery in southern California for more than 3 decades (Jarvis et al. 2014a). This pattern was persistent until the early 21st century, even following a major decline in landings beginning in 2005. Between 2011 and 2016, however, the ranking of Barred

Sand Bass in the retained catch for all fishing modes dropped rapidly from 4th to 36th place. In 2018, the ranking moved up to 15th place (Figure 2-4).

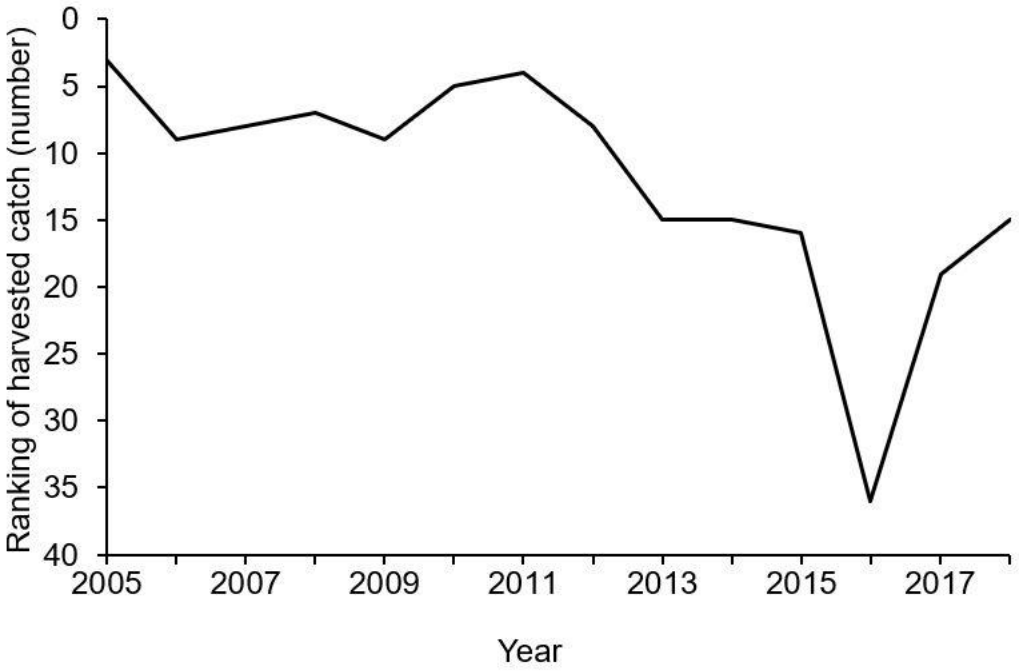

Figure 2-4. Ranking of Barred Sand Bass catch relative to other finfish species in southern California from 2005 to 2018. Results are based on the estimated retained catch for all fishing modes (RecFIN 2019).

Since historical logbook data are already summarized by month and fishing block, effort estimates by trip and specific species cannot be made. Therefore, the CPUE for this dataset was calculated as the total number of “rock bass” caught in all blocks divided by the total number of anglers. CPUE from current CPFV logs was determined by dividing the total number of Barred Sand Bass caught each year by the total number of anglers aboard trips where at least one Barred Sand Bass was caught.

CPUE for the “rock bass” complex reached a record peak in the early 1960s, followed by a dip in the 1970s and a small rebound into the 1980s (Figure 2-5 A). Recent CPUE data for CPFVs show a slow but steady increase from 1980 to the mid-2000s followed by a sharp decline up to the present day (Figure 2-5 B). At its peak, CPUE of Barred Sand Bass on CPFV trips (about two fish/angler) was high relative to other species of sea bass (e.g. Kelp Bass: about 0.7-1.5 fish/angler), because they were easily targeted in spawning aggregations (Love et al. 1996a). The CPUE of Barred Sand Bass dropped from a high of 2.4 fish per angler in 2000 to a record low of 0.2 in 2016 (Figure 2-5 B). A decline in CPUE of 50% or more was observed for CPFVs throughout most areas in the Southern California Bight between 2000 and 2012 (Figure 2-6). Private and rental boat data mirrored the decline in CPUE observed for CPFVs (Figure 2-5 C).

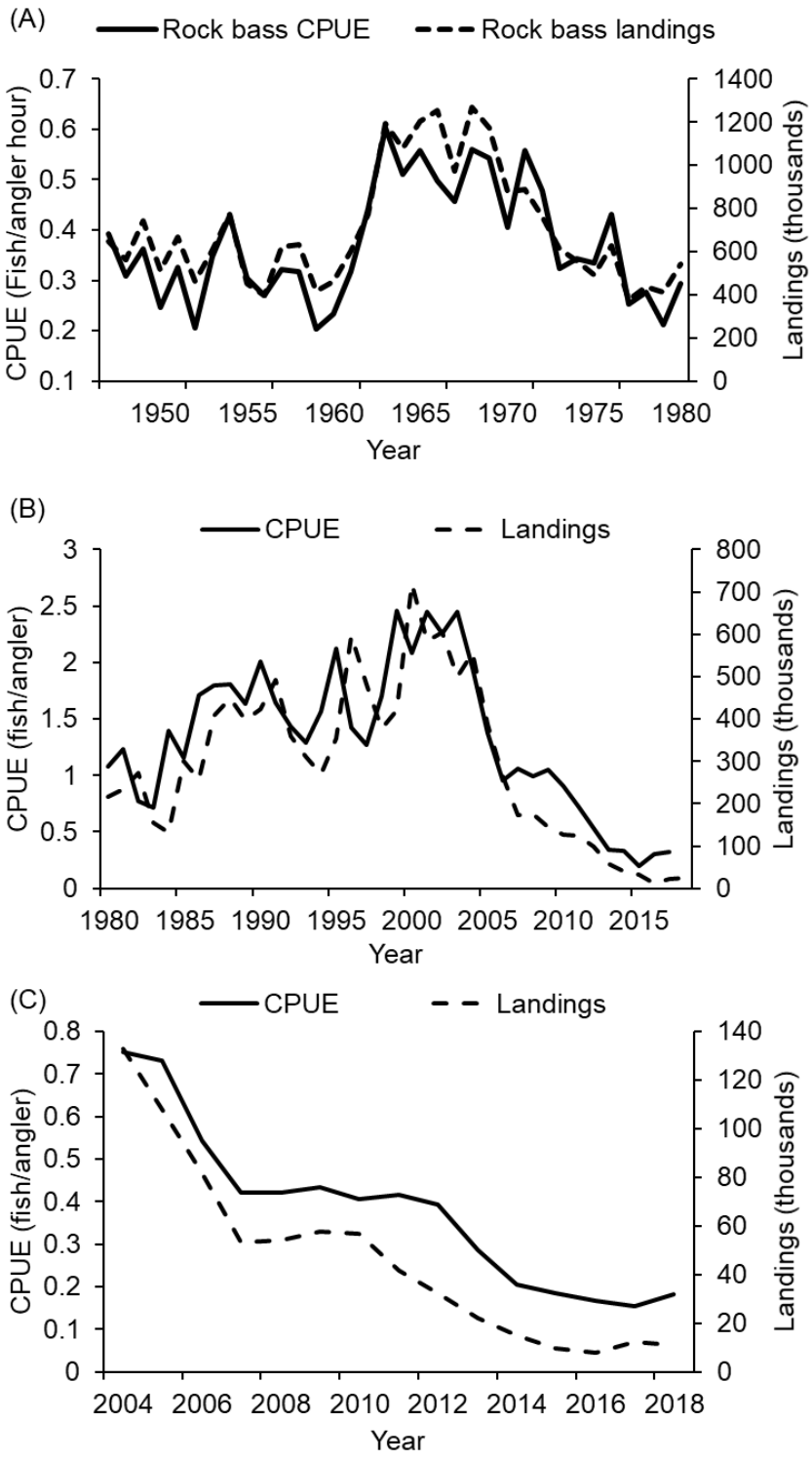

Figure 2-5. CPUE (solid line) and landings (hashed line) for (A) Rock Bass (Barred Sand Bass, Kelp Bass and Spotted Sand Bass) retained on CPFV trips from 1947 to 1980 (CDFW MLS 2018), (B) Barred Sand Bass retained on CPFV trips from 1980-2018 (CDFW MLS 2019), and (C) Barred Sand Bass retained on private/rental boats from 2004 to 2018 (RecFIN 2019).

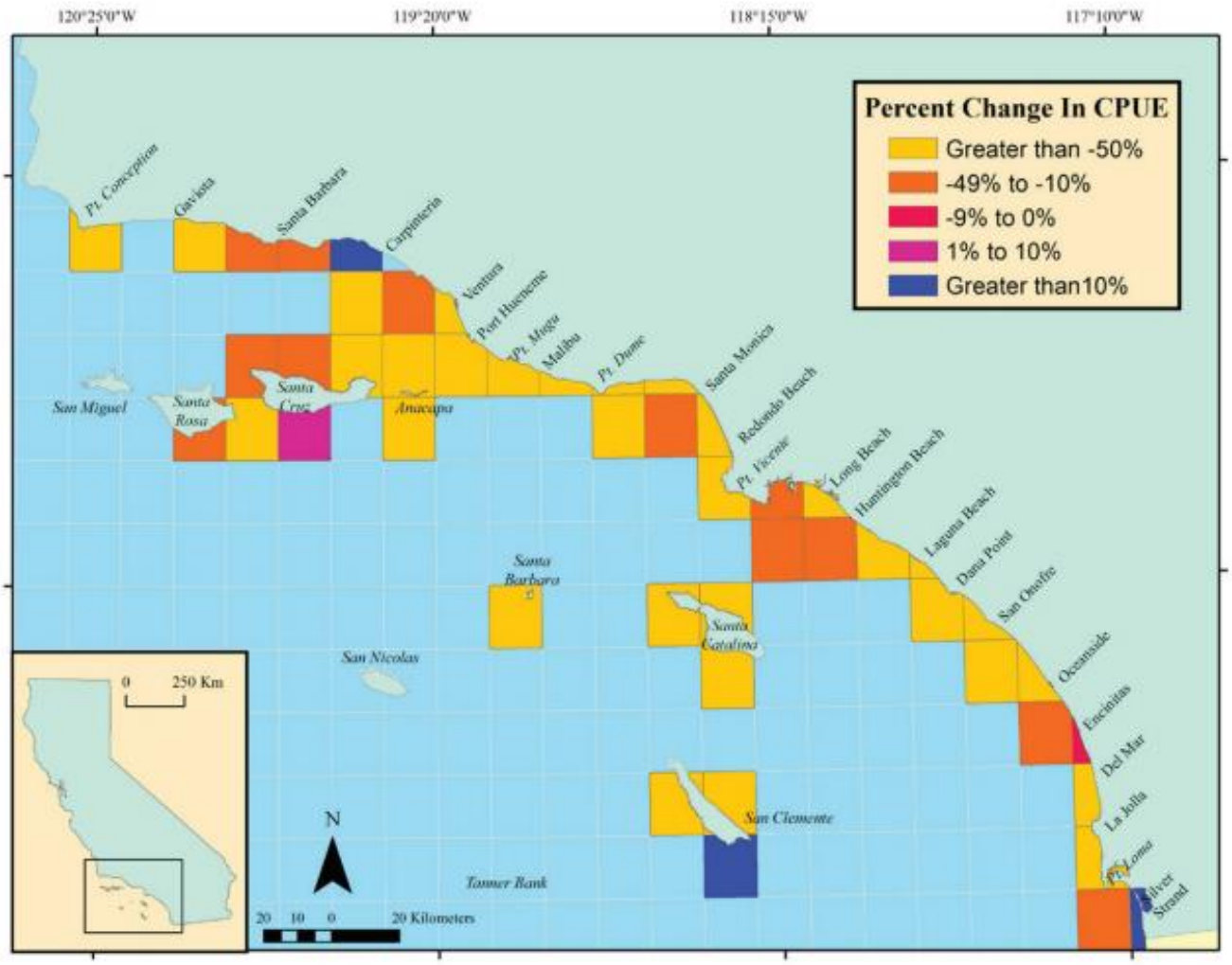

Figure 2-6. Percent change in CPUE by fishing block during peak spawning season (June to August) for Barred Sand Bass between 2000 to 2004 and late 2005 to 2012 (Reproduced from Jarvis et al. 2014a).

Temporal trends in landings for Barred Sand Bass followed the same pattern seen in CPUE. Landings from CPFVs and private/rental boats showed a steady increase through the mid-2000s followed by a sharp decline from 2005 to 2016 (Figure 2-5 B and C and Figure 2-6). A record low of 11,033 Barred Sand Bass were landed by CPFVs in 2016. This was a 97% decrease since 2000 when CPFVs landed 703,262 fish. During the July spawning season in the early 2000s up to 16,800 Barred Sand Bass were retained by CPFVs in a single day, while in 2018 the peak daily landings on CPFVs only reached 190 fish. The substantial drop in landings does not appear to result solely from reduced fishing effort for this species since a comparable trend occurred in the CPUE data (Figure 2-5 B and C). The swift drop in both CPUE and landings is attributed to prolonged overfishing of Barred Sand Bass spawning aggregations paired with poor recruitment during the cool water regime in the early 2000s (Erisman et al. 2011). The

regulation changes for Barred Sand Bass (and the other sea basses) in 2013 also contributes to the reduced landings from 2013 to 2018.

2.3.2. Commercial

In the 1930s Barred Sand Bass were only caught incidentally for commercial purposes using primarily hand and set lines. This fishery was mainly based out of Los Angeles Harbor in San Pedro (Clark 1933). The small commercial fishery that existed for all three sea bass species (Barred Sand Bass, Kelp Bass, and Spotted Sand Bass) had the highest landings during World War I, followed by another peak in the second half of the 1920s and then a general decline thereafter (Figure 2-7). The decline was associated with an increase in fishing pressure by recent veterans of the wartime industry. The commercial take of all three species was prohibited in 1953 due to concerns about sustainability of the fishery (Young 1963).

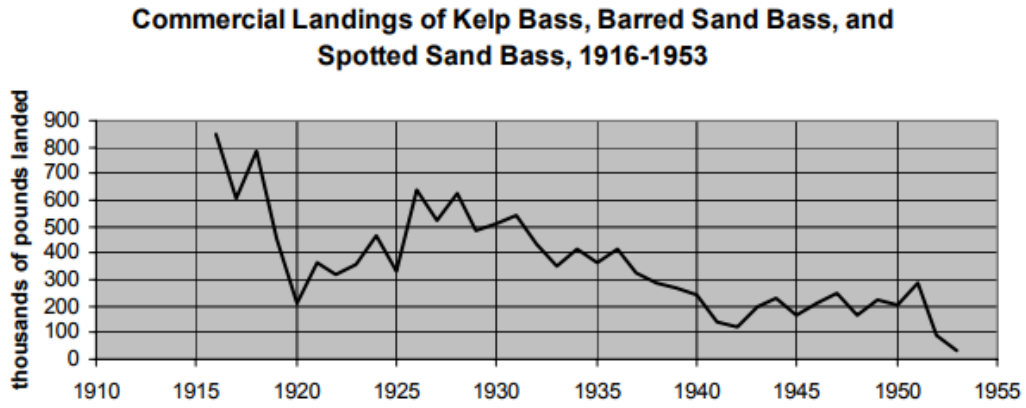

Figure 2-7. Annual commercial landings (lb) of sea basses (combined landings of Kelp Bass, Barred Sand Bass, and Spotted Sand Bass) from 1916 to 1953 (Reproduced from CDFG 2004).

2.4. Social and Economic Factors Related to the Fishery

Barred Sand Bass play a focal role in the recreational fishing industry in southern California. Historically, they have supported the most reliable short-range inshore trips for the 260 vessels that make up southern California's charter boat business (Bellquist and Semmens 2016), as well as being a target species for private boaters. Together these angling groups make up a large portion of California's $3 billion annual recreational fishing industry (Lovell et al. 2013). Recent declines in the catch of Barred Sand Bass and the disappearance of local spawning aggregations since 2013 have resulted in substantially fewer angler trips targeting this species in the summer months. This trend could critically narrow fishing opportunities for the recreational sector during years when warm water migratory species (e.g. tuna (*Thunnus* spp.) and Yellowtail (*Seriola lalandi*)) are scarce.

In the 1930s and 1940s Barred Sand Bass were not a popular sport fish, but they grew in popularity as more anglers entered the fishery. Though they are less popular than

Kelp Bass for consumption and sport, Barred Sand Bass are easy for novice anglers to target with hook and line during spawning aggregations. Hence, they have been a reliable species for CPFVs hoping to give less experienced anglers a chance to catch a fish (Love et al. 1996a; Erisman et al. 2011). A 2017 study by Bellquist et al. showed that CPFV captains in southern California think Barred Sand Bass are a very important component to the recreational fishing industry but acknowledge that the population is less healthy than Kelp Bass. This view was mainly attributed to captains that had been in the fishing industry for more than 10 yr, as captains with less experience thought the fishery was healthy (Bellquist et al. 2017). In addition, most CPFV captains felt the recreational fishery had a minimal impact on sea bass populations, and that fishery regulations were ineffective for management. This response reflects the importance of increasing public awareness of the available data and differences in life history strategies between Kelp Bass and Barred Sand Bass to improve stewardship of the fishery and to develop support for effective management decisions at the species level.

3. Management

3.1. Past and Current Management Measures

Barred Sand Bass, Spotted Sand Bass, and Kelp Bass have always been managed together as one group with a combination of minimum size and bag limits. The state legislature limited the take of “kelp bass and rock bass” in 1939 with a 15 fish aggregate bag limit (Table 3-1). Over the next decade, the bag limit changed several times and a minimum size limit was introduced in 1953. The term “rock bass” was dropped from the regulations in 1957 and the minimum size limit increased over the next few years, until reaching 12.0 in (30.5 cm) where it remained for many years. This minimum size limit was determined from age, growth, and natural mortality data to yield the maximum weight for this fishery (Young 1963). There were a few more changes to the bag limit in the 1970s, but the next regulation update did not occur for nearly 40 yr. In 2013, stricter size and bag limits were introduced to address concerns regarding the status of Barred Sand Bass and Kelp Bass populations.

Table 3-1. Historical record of southern California saltwater bass (*Paralabrax* spp.) minimum size and bag limit regulations (Adapted from Jarvis et al. 2014a).

Year	Saltwater Bass Species Listed	Regulation
1939	Kelp Bass, Rock Bass	Bag limit: 15 fish in aggregate
1949	Kelp Bass, Rock Bass	Bag limit: Ten fish in aggregate
1951	Kelp Bass, Rock Bass	Bag limit: 15 fish in aggregate, with not more than ten of any one species
1953	Kelp Bass, Rock Bass, Barred Sand Bass, Spotted Sand Bass	Cannot be sold or purchased. Minimum size limit: 26.7 cm (10.5 in) TL
1957	Kelp Bass, Barred Sand Bass, and Spotted Sand Bass	Minimum size limit: 27.9 cm (11.0 in) TL
1958	Kelp Bass, Barred Sand Bass, and Spotted Sand Bass	Minimum size limit: 29.9 cm (11.8 in) TL
1959	Kelp Bass, Barred Sand Bass, and Spotted Sand Bass	Minimum size limit: 30.5 cm (12.0 in) TL
1972	Kelp Bass, Barred Sand Bass, and Spotted Sand Bass	Bag limit: 20 fish in aggregate, with not more than ten of any one species
1975	Kelp Bass, Barred Sand Bass, and Spotted Sand Bass	Bag limit: Ten fish in aggregate, with not more than ten of any one species
2013	Kelp Bass, Barred Sand Bass, and Spotted Sand Bass	Bag limit: Five fish in aggregate; Minimum size limit: 35.6 cm (14.0 in) TL

3.1.1. Overview and Rationale for the Current Management Framework

Minimum size limits are set to allow fish to live long enough to reproduce for one or more seasons before reaching a size at which they can be legally retained. The current size limit of 14.0 in (35.6 cm) corresponds with fish that are 7-plus yr of age and allows for several years of spawning before fish can be legally taken by the fishery. Bag limits are typically utilized to limit the number of reproducing individuals that can be removed from the population. When fishing a spawning aggregation of Barred Sand Bass, anglers could easily reach the previous bag limit of ten fish per angler. The current reduced bag limit of five fish (in combination with Kelp Bass and Spotted Sand Bass) is designed to limit the impact of fishing on this stock.

3.1.1.1. Criteria to Identify When Fisheries Are Overfished or Subject to Overfishing, and Measures to Rebuild

The Department has not established overfishing criteria for the Barred Sand Bass fishery. There is no specific trigger for making a regulation change in this fishery and any decision to re-evaluate the current management strategy is based on supporting evidence from multiple sources. Prior to the regulation change in 2013 staff noted a concurrent and sustained drop in catch rates and relative fish abundance, paired with a potential recruitment failure, as described in Jarvis et al. (2014a).

Department staff continue to monitor catch, effort and size trends annually, utilizing both fishery-dependent and fishery-independent datasets. These data are evaluated relative to historic trends and environmental factors (Jarvis et al. 2014a). A stock assessment and FMP have not been completed for the Barred Sand Bass resource. Sustainability of the fishery is being evaluated through various methods including the Data Limited Methods Toolkit to conduct a Management Strategy Evaluation (MSE) of alternative rebuilding methods and length at age-based models. Staff are also monitoring the effectiveness of the size and bag limit implemented in 2013 by sampling the number and size of Barred Sand Bass discarded in the CPFV fishery. Since more reproductively mature Barred Sand Bass are now left in the population (i.e. 12-14 in fish) we expect that more offspring are being produced. Thus, as these offspring reach a size that is susceptible to harvest, at 5 or 6 yr of age, we expect to see a more even distribution of younger age classes of sublegal fish in the discards as the new recruits enter the fishery. As these fish reach legal size at about 8 yr, an increase in the ratio of kept to discarded fish should also occur. Therefore, if the number of kept fish does not increase and we do not observe large cohorts of sublegal fish entering the fishery as discards in the 5 to 10 yr following the regulation change, further regulation change may be needed.

3.1.1.2. Past and Current Stakeholder Involvement

Stakeholder involvement has primarily occurred during regulation changes for the sea basses. The last regulation change increased the minimum size limit and decreased the bag limit (§28.30, Title 14, CCR). Leading to the regulation change various stakeholder groups including Tribes, CPFV operators, recreational anglers, spearfishers, Non-Government Organizations (NGOs), other scientists, and the general public were consulted and given the opportunity to comment throughout the Commission process. A series of informative presentations by Department staff experts on the topic engaged stakeholders and stakeholder input was considered.

To create effective future management strategies for Barred Sand Bass, the Department will continue to involve stakeholders when regulation changes or novel approaches to managing the fishery are being considered, when FMPs are being developed, and if new collaborative opportunities arise for research and monitoring.

3.1.2. Target Species

3.1.2.1. Limitations on Fishing for Target Species

3.1.2.1.1. Catch

The Department continues to manage the three sea bass species (Kelp Bass, Barred Sand Bass, Spotted Sand Bass) together. There is a bag and possession limit of five fish in any combination of species (§28.30, Title 14, California Code of Regulations (CCR)).

3.1.2.1.2. Effort

Currently, there are no regulatory limitations on effort. Only a sport fishing license is required for recreational anglers not fishing off a pier.

3.1.2.1.3. Gear

Barred Sand Bass are taken by hook and line or by spear only. Recreational anglers fishing from boat or shore may use any number of hooks and lines, while anglers on public piers may use no more than two lines.

3.1.2.1.4. Time

The Barred Sand Bass fishery is open year-round.

3.1.2.1.5. Sex

Both sexes of Barred Sand Bass may be taken in the recreational fishery, as it is not possible to determine sex externally.

3.1.2.1.6. Size

The Department continues to manage the three sea bass species together. For Kelp Bass, Barred Sand Bass and Spotted Sand Bass, there is a minimum size limit of 14.0 in (35.6 cm) TL or 10.0 in (25.4 cm) alternate length (defined as the length from the base of the foremost spine of the dorsal fin to the longest tip of the tail) (§28.30, Title 14, CCR). The three bass species also have a fillet length regulation that permits the filleting of legal-sized bass aboard vessels while at sea. All species of bass fillets must be a minimum of 7.5 in (19.1 cm) length and bear intact a one in square patch of skin in order to aid in identifying the fish species for enforcement purposes (§27.65(1), Title 14, CCR).

3.1.2.1.7. Area

There are no restrictions on where Barred Sand Bass may be fished except for inside Marine Protected Areas (MPAs).

3.1.2.1.8. Marine Protected Areas

Pursuant to the mandates of the Marine Life Protection Act (Fish and Game Code (FGC) §2850), the Department redesigned and expanded a network of regional MPAs in state waters from 2004 to 2012. The resulting network increased total MPA coverage from 2.7% to 16.1% of state waters. Along with the MPAs created in 2002 for waters surrounding the Santa Barbara Channel Islands, California now has a statewide scientifically-based ecologically connected network of 124 MPAs. The MPAs contain a wide variety of habitats and depth ranges.

The MPAs contain a wide variety of habitats and depth ranges. However, the MPA network was not designed to specifically benefit a single species such as Barred Sand Bass, which are most vulnerable to fishing when they spawn over soft bottom habitat. It is unclear how much protection will be afforded to adult Barred Sand Bass from southern California's MPAs, though it is likely insignificant given most fishing pressure has historically focused on their spawning aggregations in areas that are largely unprotected (Erisman et al. 2011). Of the MPAs within their home range in southern California, only the South La Jolla State Marine Reserve and the Tijuana River Mouth State Marine Conservation Area protect small portions of known spawning sites off La Jolla (Semmens and Parnell 2014) and Silver Strand (Love et al. 1996a), respectively. For more information on the specific Southern California MPAs visit our website at https://wildlife.ca.gov/conservation/marine/mpas/network/southern-california.

3.1.2.2. Description of and Rationale for Any Restricted Access Approach

The recreational Barred Sand Bass fishery is an open access fishery.

3.1.3. Bycatch

3.1.3.1. Amount and Type of Bycatch (Including Discards)

FGC §90.5 defines bycatch as “fish or other marine life that are taken in a fishery but which are not the target of the fishery.” Bycatch includes “discards,” defined as “fish that are taken in a fishery but are not retained because they are of an undesirable species, size, sex, or quality, or because they are required by law not to be retained” (FGC §91). Since recreational anglers targeting Barred Sand Bass are often targeting a suite of other fishes as well, the Department classifies these fishes commonly targeted and caught in association with Barred Sand Bass as incidental catch. The Master Plan defines incidental catch as fish caught incidentally during the pursuit of the primary target species that are legal and desirable to be sold or kept for consumption. In order to assess the most commonly caught species with Barred Sand Bass, all trips where at least one Barred Sand Bass was caught were analyzed. This eliminates offshore fishing trips that solely target pelagic species; however, it is not possible to avoid trips where effort is split between multiple habitats, and both nearshore and offshore species are landed on the same trip. The most common species caught in 2017 on CPFV trips where Barred Sand Bass was caught included Kelp Bass, California Scorpionfish (*Scorpaena guttata*), unspecified rockfishes, Ocean Whitefish (*Caulolatilus princeps*), Pacific Mackerel (*Scomber japonicus*), Pacific Bonito (*Sarda chiliensis*), Blacksmith (*Chromis punctipinnis*), Pacific Barracuda (*Sphyraena argentea*), Vermilion Rockfish *(Sebastes miniatus*), and California Sheephead (*Semicossyphus pulcher*) (Table 3-2). Although Barred Sand Bass were caught on 100% of these trips, they are often not the most abundant species. These other species may be primary targets or secondary targets on CPFV trips that may, or may not, be targeting Barred Sand Bass. Note that most of these species are also associated with Barred Sand Bass habitat (see Section 1.4.1). However, species such as Pacific Mackerel, Bonito and Barracuda which are not associated with Barred Sand Bass habitat are likely caught on the same trips due to switching between fishing nearshore and offshore areas. All species listed in Table 3-2 have state or federal management measures in place.

Table 3-2. Number caught and percent of trips (frequency of occurrence) for the top ten most abundant species on CPFV trips (n=3,252) where at least one Barred Sand Bass was also caught in 2018 (CDFW MLS 2019).

Species	Number caught	Percent of trips	Number of Barred Sand Bass caught on associated trips
Kelp Bass	127987	72	36047
California Scorpionfish	52695	36	17933
Barred Sand Bass	**50541**	**100**	**50541**
Unspecified rockfish	41444	35	13118
Ocean Whitefish	38735	32	11800
Pacific Mackerel	14243	11	2917
Pacific Bonito	12660	12	4559
Blacksmith	12448	8	4085
Pacific Barracuda	10430	14	9366
Vermilion Rockfish	6579	7	1744
California Sheephead	4430	29	11399

Catching any species whose take is prohibited is of special concern. Of the species that are prohibited from recreational take, Giant Sea Bass (*Stereolepis gigas*), and Cowcod (*Sebastes levis*) were the only species recorded as caught and discarded on CPFV trips in 2018 where at least one Barred Sand Bass was also caught. No information is available on whether these fish were discarded dead or alive. However, the reported numbers and frequency of these occurrences are extremely low (Table 3-3).

Table 3-3. Species prohibited from recreational take that were caught aboard CPFV trips along with Barred Sand Bass in 2018 (CDFW MLS 2019).

Species	Number caught	Percent of trips
Giant Sea Bass	27	0.7
Cowcod	9	0.1

Catch and release rates of the target species are relatively high in the Barred Sand Bass fishery, with 55% of Barred Sand Bass being released between 2004 and 2013 according to CRFS data (CDFW 2014). Catch and release fishing was historically popular with sea bass anglers because of the perception that the discards will survive and promote the conservation of the fishery (Semmens and Parnell 2014).

Discards may include both legal and sublegal fish, however, there is limited size information on discarded fish. Size frequency data from CRFS suggests that >75% of discarded Barred Sand Bass each year were sublegal between 2003 and 2018, with the exception of 2004 and 2011(Figure 3-1 A).

The estimated number of Barred Sand Bass discarded annually from both CPFVs and private boats peaked at the height of the fishery in the early 2000s (91,000 and 316,000 discards, respectively), followed by a steady decline (Figure 3-1 B and C). Annual discards for both modes remain low as of 2018 (approximately 25,000 and 83,000, respectively). The number of Barred Sand Bass Discarded Per Unit Effort (DPUE) from CPFVs and private boats also decreased from a peak in the early 2000s until rebounding in 2013 (Figure 3-1 B and C). The rise in DPUE in 2013 probably reflects the increased minimum size limit implemented that year. Following 2013, DPUE fell again, before showing signs of a substantial increase into 2017 for both fishing modes. The increase in DPUE suggest that a successful recruitment event occurred during the warm water El Niño phase of 2014 to 2016. More juvenile Barred Sand Bass were also observed on fishery-independent surveys during this time period (Figure 1-4 and 1-6). The total number of discards remains low in a historical context because the absence of spawning aggregations has resulted in fewer targeted fishing trips. However, the positive trend in DPUE for trips that do target the species suggests a new cohort of sublegal fish may appear in the catch throughout the next 5 to 7 yr.

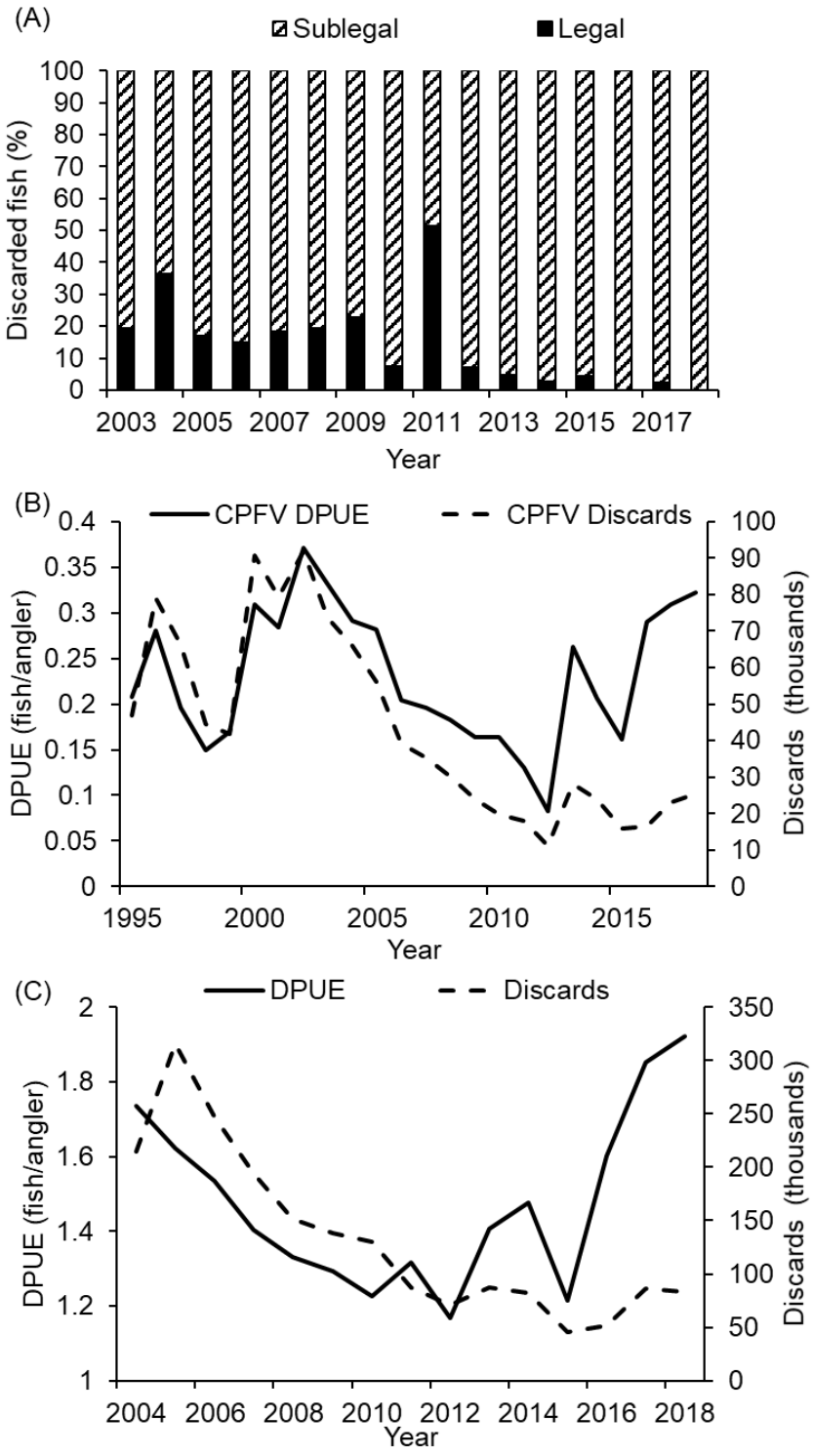

Figure 3-1. (A) Annual trends in the proportion of sublegal and legal Barred Sand Bass discarded from CPFVs (RecFIN 2019) and annual trends in bycatch of Barred Sand Bass presented as discards per unit effort (DPUE, solid line) and the total number of discards (hashed line) for (B) CPFVs (CDFW MLS 2019) and (C) private/rental boats (RecFIN 2019).

Discard mortality results from a combination of sources including fishing-related trauma and predation by California Sea Lions (*Zalophus californianus*), sea birds, Harbor Seals

(*Phoca vitulina*) and other fish. The initial post-release mortality of Barred Sand Bass is estimated at 0.92% and short-term (10 days) mortality is estimated at 3.1% (Semmens and Parnell 2014). The Department has collected similar data from 2013 to 2018 and estimates initial post-release mortality to be 0.42%; however, incidence of barotrauma was estimated at 26% and may increase short-term mortality.
Most discarded Barred Sand Bass are quickly released back into the water at the same location. Since the mortality rate is relatively low, it is unlikely there is any substantial impact to the Barred Sand Bass population or ecosystem. However, to better understand the total impacts of bycatch, further research on the long-term survivorship of discarded Barred Sand Bass is needed as current mortality estimates are only based on initial and short-term observations.

3.1.3.2. Assessment of Sustainability and Measures to Reduce Unacceptable Levels of Bycatch

As described above, the bycatch in the Barred Sand Bass fishery is primarily other shallow reef and coastal pelagic species that are monitored and managed separately. While some sensitive or protected species are caught in the CPFV fishery for Barred Sand Bass, the reported numbers caught per year are low, and all were released. This fishery has not had any adverse interactions with marine mammals and while seabirds are sometimes hooked by anglers or tangled in fishing line, further research is needed to determine the degree of impact to individual birds and their populations. While the proportion of Barred Sand Bass discarded is high, preliminary data on the rate of instantaneous mortality suggests that discard mortality is low (CDFW unpublished data). However, as mentioned in Section 3.1.3.1, further information on the long-term survivorship of discards is needed to fully evaluate the effect of discards on the population. For these reasons, the Department does not consider the type and amount of bycatch for the Barred Sand Bass fishery to be at an unacceptable level and measures have not been developed to reduce it.

3.1.4. Habitat

3.1.4.1. Description of Threats

Coastal development and urban runoff can pose a risk to inshore nursery habitats due to negative effects on water quality and the persistence of eelgrass (Zedler 1996). Additionally, the growth and body condition of adult Barred Sand Bass on coastal rocky reefs are negatively affected by high levels of organic pollutants in areas such as Los Angeles and Long Beach Harbor in Los Angeles County and Huntington Flats in Orange County (Sanchez 2015). Invasive species, climate change and increased variability in sea surface temperatures may also have detrimental effects on the health of nearshore kelp forest and rocky reef ecosystems (Caselle et al. 2017; Provost et al. 2017; Ramírez-Valdez et al. 2017).

3.1.4.2. Measures to Minimize Any Adverse Effects on Habitat Caused by Fishing

The Barred Sand Bass fishery is mainly a hook and line recreational fishery; some spearfishing does occur. Adverse impacts of the Barred Sand Bass recreational hook and line fishery on soft bottom, rocky reef, and kelp forests habitats are most likely insignificant. Some impact to kelp forests or marine invertebrates associated with rocky reef or soft bottom substrates can result from anchoring of vessels or fishing gear snagging on structure or organisms, but this is likely minimal. The impacts of a hook and line fishery on habitats is likely very minor and measures to minimize them have not been developed.

3.2. Requirements for Person or Vessel Permits and Reasonable Fees

Unless recreationally fishing off a public pier, all anglers 16-yr-old or older are required to purchase a fishing license to fish for Barred Sand Bass. A Recreational Ocean Enhancement Stamp (Validation) is required for any person taking fish south of Point Arguello (Santa Barbara County). Captains operating their vessels as CPFVs or private charters must purchase a permit. In 2019, the cost of an annual resident sport fishing license is $49.94, and an Ocean Enhancement Validation is $5.66 (Table 3-4). The most current license options, fees, and other information for recreational fishing may be accessed at https://wildlife.ca.gov/Licensing/Fishing and https://wildlife.ca.gov/Licensing/Commercial/Descriptions.

Table 3-4. Annual sport fishing license fees from January 1 to December 31, 2019. Accessed June 24, 2019 at https://www.wildlife.ca.gov/Licensing/Fishing and https://wildlife.ca.gov/Licensing/Commercial/Descriptions.

License	Fee	Description
Commercial Passenger Fishing Vessel License	$379	Required for any boat from which persons are allowed to sport fish for a fee.
Resident Sport Fishing	$49.94	Required for any resident 16 years of age or older to fish.
Recreational Non-resident Sport Fishing	$134.74	Required for any non-resident 16 years of age or older to fish.
Recreation Ocean Enhancement Validation	$5.66	Required to fish in ocean waters south of Point Arguello (Santa Barbara County). An Ocean Enhancement Validation is not required when fishing under the authority of a One or Two-Day Sport Fishing License.
Reduced-Fee Sport Fishing License – Disabled Veteran	$7.47 at CDFW offices. $7.82 from license agents	Available for any resident or non-resident honorably discharged disabled veteran with a 50% or greater service-connected disability. After you prequalify for your first Disabled Veteran Reduced-Fee Sport Fishing License, you can purchase disabled veteran licenses anywhere licenses are sold.
Reduced-Fee Sport Fishing License – Recovering Service Member	$7.47	Available for any recovering service member of the US military. The Recovering Service Member Reduced-Fee Sport Fishing License is only available at Department License Sales Offices.
Reduced-Fee Sport Fishing License – Low Income Senior	$7.47	Available for low income California residents, 65 years of age and older, who meet the specified annual income requirements. The Reduced-Fee Sport Fishing License for Low Income Seniors is only available at Department License Sales Offices.

4. Monitoring and Essential Fishery Information

4.1. Description of Relevant Essential Fishery Information

FGC §93 defines Essential Fishery Information (EFI) as “with regard to a marine fishery, means information about fish life history and habitat requirements; the status and trends of fish populations, fishing effort, and catch levels; fishery effects on fish age structure and on other marine living resources and users, and any other information related to the biology of a fish species or to taking in the fishery that is necessary to permit fisheries to be managed according to the requirements of this code.” There are many studies on life history EFI for Barred Sand Bass as described in Section 1, including age and growth, breeding aggregations, and movement. This Chapter however summarizes the EFI that is routinely collected and used to monitor the health of the stock and ecosystem. The Department relies on a combination of fishery-dependent and fishery-independent sources to monitor the status of the Barred Sand Bass fishery.

4.2. Past and Ongoing Monitoring of the Fishery

4.2.1. Fishery-dependent Data Collection

Fishery-dependent data collected by the Department provide an excellent way to monitor fishing effort, catch levels and the size structure of retained Barred Sand Bass. Fishery data are collected from CPFV logbooks and from all fishing modes sampled by CRFS. Both CPFV logbook and CRFS data collected by the Department contribute valuable estimates of catch and effort that help staff monitor the status of Barred Sand Bass.

Beginning in 1935, CPFV operators were required to keep daily catch logs and submit them monthly to the Department. These data have been collected continuously, except for during World War II (1941 to 1946) when most CPFVs were not fishing (Hill and Schneider 1999). Logbook data have always included the date fishing occurred, port code, boat name, Department fishing block, angler effort and the number of fish kept by species, and after 1994 included discarded fish, bait type and sea surface temperature. However, Barred Sand Bass were initially recorded within the broader “rock bass” category (which also included Kelp Bass and Spotted Sand Bass) and were not consistently reported by species until 1975. Although initially recorded on paper, as of December 2017, 70% of all CPFV logs are voluntarily entered via the MLS electronic application which is accessible to Department scientists.

All modes of recreational fishing were surveyed by Marine Recreational Fisheries Statistics Survey (MRFSS) for estimates of catch and effort between 1979 and 2003. The Pacific States Marine Fisheries Commission ran these surveys with both federal

and state funding. A combination of dockside surveys, CPFV sampling and phone interviews were used to generate the estimates. In January 2004, the Department implemented its own sampling survey, CRFS, to replace the MRFSS surveys using similar but different methods.

Current CRFS estimates (2004 to present) use catch and effort data collected by samplers from all fishing modes. In addition, CRFS also collects size (length and weight) information on kept fish. Numbers of discards are also recorded for all modes and discard lengths are obtained opportunistically on CPFVs. Estimates from CRFS and MRFSS are not directly comparable due to differences in methodology, so only CRFS data are presented in this report. CRFS data on catch estimates and mortality are available electronically to the public within 40 days of collection on the updated RecFIN website (https://www.recfin.org).

To evaluate the effectiveness of the 2013 sea bass regulation change, the Department is conducting an ongoing study monitoring the bass discard rates aboard CPFVs. The purpose of this study is to collect the number, lengths, and incidence of barotrauma and mortality of discarded bass at various locations in southern California. This increase in monitoring of CPFV trips that are specifically targeting the basses will aid in evaluating the effectiveness of raising the minimum size limit from 12.0 to 14.0 in (30.5 to 35.6 cm). As of early 2019 the study has been collecting data for 5 yr and the study will continue for the next 3 to 5 yr. Data on barotrauma and mortality of discarded fish will fill valuable data gaps on fishing mortality that can be applied to stock assessments and fishery models. Data on the size and number of fish discarded will be used to evaluate the effectiveness of the 2013 regulation change, as described in detail in Section 3.1.1.1 and help inform the need for additional management measures.

4.2.2. Fishery-independent Data Collection

Fishery-independent data can provide a better, less-biased assessment of relative abundance since sampling can be standardized and information on all life stages can be collected. In addition, trends in fishery-dependent data for this species can be masked by hyperstability, or artificially high catch rates, since anglers target aggregations rather than an evenly distributed population (Erisman et al. 2011).

Fishery-independent data on Barred Sand Bass are available from various sources and involve different temporal and spatial scales. Records of fish entrainment in the cooling water intakes of southern California’s coastal electric generating stations provided a useful dataset from 1979 to 2010 (Miller and Erisman 2014). However, these data became unavailable after 2012 following the shutdown of major power plants like San Onofre Nuclear Generating Station. New regulations now prevent active power plants from using once-through cooling of seawater due to the damaging environmental impacts. Quarterly plankton tows conducted by CalCOFI that began in 1951 provide

annual estimates of recruitment for basses (Jarvis et al. 2014a). However, these data are less useful since similarities in larval physiology prevent identification to species, and available larvae counts summarize trends for all three sea bass species combined. Finally, Occidental College's Vantuna Research Group has conducted quarterly SCUBA surveys of fish assemblages (including Barred Sand Bass) along the breakwater and artificial reef at King Harbor (Redondo Beach, California) since 1974 (Stephens Jr et al. 1994; Pondella et al. 2002). These surveys provide one of the few long-term fishery-independent datasets for the relative abundance of Barred Sand Bass in their primary habitat in southern California. The Department is currently investigating the use of Baited Remote Underwater Videos (BRUVs) and SCUBA surveys in other areas to determine relative abundance of Barred Sand Bass over time at natural and artificial reef sites.

5. Future Management Needs and Directions

5.1. Identification of Information Gaps

Additional EFI data are necessary for effectively monitoring the Barred Sand Bass resource. A long-term fishery-independent monitoring program for Barred Sand Bass is in development by Department scientists (see Section 4.2.2). Hydroacoustic transects using split-beam sonar may also be a useful method for assessing annual variability in the total size of local spawning aggregations (Allen 2013).

Although EFI on age and growth of Barred Sand Bass exists, the Department is updating this information with more current and larger sample sizes. There is also uncertainty regarding long-term mortality associated with hook and line catch and release practices (Table 5-1). A formal stock assessment of Barred Sand Bass using existing and new EFI would also be helpful in the sustainable management of the fishery. However, an effective stock assessment would depend on reliable estimates of fishery indicators from the beginning of the fishery, when fishing pressure was light, and these data are rarely available for recreational fisheries in California.

Table 5-1. Informational needs for Barred Sand Bass and their priority for management.

Type of information	Priority for management	How essential fishery information would support future management
Long term post-release mortality	High	Quantifying long-term discard mortality is necessary for a more accurate estimate of overall fishing mortality.
Hydroacoustic transects using split-beam sonar	High	Information used to assess annual variability in total size of local spawning aggregations.
Formal Stock Assessment	High	Information used to estimate spawning stock biomass and maximum sustainable yield.
Updated estimate of natural mortality	Medium	Natural mortality estimates are used in the calculation of total mortality. Estimated total mortality rates are utilized in stock assessments and when modeling forward projections of the fishery.
Estimate of amount of money the fishery contributes to California's economy	Medium	This information would be the goal of a socioeconomic analysis that would be useful when assessing how changes in the fishery impact the economy.
Estimate of how changes in fishery affect CPFV industry	Medium	Information useful when considering regulation changes.
Updated length and weight at age	Low	Parameters calculated from this information will be used to calculate an updated growth curve.
Updated length and age at maturity	Low	Provides information about what size and age Barred Sand Bass first become mature, when 50% are mature, when most are expected to be mature, and any differences between sexes. Minimum size lengths are chosen based on these lengths to allow fish to spawn before they can be legally retained.
Genetics	Low	Information used to assess the connectivity of populations and the degree of vulnerability of the species based on local population genetic profiles
GIS analysis of catch in relation to habitat types and MPA locations	Low	Information used to determine what percentage of catch occurs in each habitat type. This helps to evaluate new MPAs relative to historic fishing.

5.2. Research and Monitoring

5.2.1. Potential Strategies to Fill Information Gaps

Department staff will continue to use CPFV logbook and CRFS data to monitor Barred Sand Bass fishery trends. The Department will also continue to search for and

incorporate any relevant results from other fishery-dependent or fishery-independent studies conducted by others. As mentioned above, additional fishery-independent indices of abundance for Barred Sand Bass will be important for monitoring future trends in the stock. This may require a combination of efforts led by the Department and independent researchers through various grants or other funding sources. Studies could include temporal surveys of the relative abundance and the size of Barred Sand Bass within spawning aggregations in southern California. Moreover, an estimate of long-term discard mortality will be useful to the Department to understand whether restrictive size limits result in increased mortality of sublegal size classes. Research efforts like these may be particularly well suited for graduate studies at local universities.

5.2.2. Opportunities for Collaborative Fisheries Research

The Department has collaborated in the past and will continue to work with outside entities such as academic organizations, NGOs, citizen scientists, and both commercial and recreational fishery participants to help fill information gaps related to the management of state fisheries. The Department will also reach out to outside persons and agencies when appropriate while conducting or seeking new fisheries research required for the management of Barred Sand Bass. Several of the information gaps identified above (Section 5.1) are potential areas for collaboration. In particular, hydroacoustic surveys to determine Barred Sand Bass abundance and discard studies to determine long-term catch and release mortality are good subjects for collaborative studies, potentially involving both anglers and academic entities.

5.3. Opportunities for Future Management Changes

This section is intended to provide information on changes to the management of the fishery that may be appropriate, but does not represent a formal commitment by the Department to address those recommendations. ESRs are one of several tools designed to assist the Department in prioritizing efforts and the need for management changes in each fishery will be assessed in light of the current management system, risk posed to the stock and ecosystem, needs of other fisheries, existing and emerging priorities, as well as the availability of capacity and resources.

While the sea basses have historically been managed as a group, Barred Sand Bass require species-specific management options that account for their unique life history traits. Therefore, the Department may consider separate, species-specific regulations to meet the individual needs of each stock. The need for species-specific management is evident based on differing responses of Kelp Bass and Barred Sand Bass to the 2013 regulation change. Although more stringent bag and size limits were implemented by the Commission in 2013, Barred Sand Bass populations continue to be depressed and their spawning aggregations have essentially disappeared. Conversely, landings for Kelp Bass have shown an upward trajectory (Bellquist et al. 2017). The life history

strategy of Barred Sand Bass makes them much more vulnerable to overfishing than the other sea basses. Most notably, Barred Sand Bass form larger, predictable spawning aggregations that are easily accessible to anglers (Jarvis et al. 2010), while Kelp Bass form smaller, more dispersed spawning aggregations within complex habitats (Erisman and Allen 2006). For example, more than 16,000 Barred Sand Bass were landed on CPFVs in a single day during peak spawning season in 2004 (CDFW MLS) while daily landings only reached a maximum 4,000 fish at the peak of the fishery for Kelp Bass in 1992 (CDFW MLS). Thus, the vulnerability of Barred Sand Bass during their spawning period is not comparable to Kelp Bass.

Vulnerability to overfishing is an issue for aggregative spawners globally, and evidence suggests that a more precautionary approach to management for these species is necessary (Sadovy de Mitcheson 2016). However, management strategies must be tailored to the unique aspects of each fishery. Management initiatives, including a concurrent low bag limit (one fish), slot limit and quota-tags to establish a total allowable catch, have been successfully implemented for recreational fisheries targeting aggregative species in Australia (Jackson and Moran 2012). In other cases, seasonal or site-specific closures have been effective (Erisman et al. 2015). Potential management strategies for Barred Sand Bass may include a more restrictive bag limit or spawning season closure.

The Department is currently prioritizing fisheries within the Master Plan update and exploring how to utilize an MSE approach with certain fisheries. MSE simulates the performance of a fishery in the future by testing a multitude of alternative management procedures against a set of performance metrics and evaluates the tradeoffs. The Department is currently developing a model of the Barred Sand Bass population to conduct an MSE using the Data Limited Toolkit platform. It is hoped this analysis will provide information about what management measures are most likely to meet management objectives, as well as the tradeoffs between different management measures. A formal stock assessment on the Barred Sand Bass fishery would also aid in the sustainable management of this fishery.

5.4. Climate Readiness

Little is known about how climate change may affect Barred Sand Bass populations and habitats. To incorporate climate readiness into Barred Sand Bass management it is important to increase our understanding of possible impacts of climate variability. California’s coastal waters are already subject to high variability due to episodic events such as ENSO, PDO and NPGO. Climate change will bring even further uncertainty to these trends, with potentially extreme implications for ecosystem function and fishery sustainability in coastal areas. To manage Barred Sand Bass populations effectively under climate change, it will be important to take a proactive approach to management. This may entail increased or targeted monitoring of populations and/or precautionary

management measures until the uncertainties associated with climate change can be better understood.

Climate change that results in warmer ocean temperatures could have both positive and negative effects on Barred Sand Bass populations. Since bass recruitment declines during cold-water periods and spikes during warmer water regimes (Jarvis et al. 2014a), sustained warmer water periods may result in population growth and push the fishery further north. An overall increase in sea surface temperature may alter the timing and location of Barred Sand Bass spawning aggregations with spawning occurring either later or earlier in the season. This could make any specific regulations that are put in place to protect these aggregations less effective unless routine monitoring is conducted to detect changes in the spatial and temporal distributions of spawning aggregations. Ocean acidification may have a negative impact on prey availability for Barred Sand Bass, especially for hard-shelled invertebrates.

Protecting the health of key habitats for Barred Sand Bass is a priority for climate readiness. This might involve protection of spawning grounds, removal and monitoring for invasive species, and regulation of coastal runoff. Finally, increased monitoring of environmental variables, fish abundance and distribution from all available data sources will be important to anticipate change and take proactive management actions.

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